DIY

Worthwhile projects you can build on your own

Trap dipole antenna for 20 and 40 meters

Similar to what I had built two years ago, I thought I'd present another dual-band HF dipole antenna, for 20 meters and 40 meters, but this time using a single wire pair, instead of two pairs of elements. But doing so requires me to make for each dipole side what's known as a ***trap***, which is nothing more than a tank circuit (capacitor and inductor in parallel) made out of coaxial cable and PVC.

The trap allows signals of all frequencies to pass through it, except those around 14.175 MHz, which is close to the center of the 20-meter band. So, a 20-meter signal will become attenuated (stop at, not pass through) the trap, but a 40-meter (and 10-meter, 80-meter, etc.) signal will go straight through the trap, as though it didn't even exist.

Furthermore, the length of the elements between the balun (transformer-less center insulator, actually) and the trap present a near-50-ohm impedance to the rig at 20 meters. And the length of the element on the other side of the trap presents a near-50-ohm impedance at 40 meters. Therefore, the rig will treat the antenna as though it was both a 20-meter antenna and a 40-meter antenna.

Parts list

60 feet of 14 AWG stranded wire

Two 1-¼″ PVC slip caps

Three 1-½″ x 3/16″ eye bolts

One SO-239 bulkhead connector

#8 screw, nuts, flat washers, split washers

6″ 16 AWG speaker wire pair

One 1-¼″ 24″ long PVC tube

Twelve 16 AWG #8 stud ring terminals

6 feet of RG-58 coax (for the traps)

4 each M3 screws, split washers, nuts

Two dogbone insulators (you can fabricate these from ½″ PVC, about 3″ long each)

Transformer-less "balun" construction

Drill a 3/16″ hole in the center of one of the slip caps, and install an eye bolt through a flat washer on the outside of the cap. Slip another flat washer onto the eye bolt on the inside, followed by a split washer, then tighten a nut onto the eye bolt of the slip cap assembly and set aside.

Drill a 7/16″ hole in the center of the other slip cap. If your slip cap is domed (most are), rather than flat, it'll help with the installation to sand the outside of the cap so that the entire flange of the SO-239 bulkhead sits flush with the cap. Insert the solder end of the SO-239 bulkhead into the 7/16″ hole on the outside of the cap, and using the mounting holes of the bulkhead as a template, drill a 1/8″ hole for each mounting hole. Drill two more 1/8″ holes in

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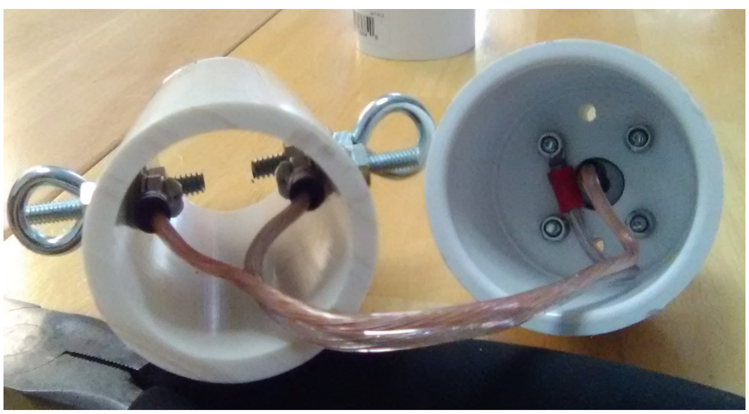
the slip cap next to the SO-239 bulkhead flange, to allow for drainage of rain water that might collect inside the balun.

Strip both sides of each end of the 6″ speaker wire pair. Solder a #8 ring terminal to each conductor of one end, and a #4 ring terminal to one of the conductors of the other end. Slip a piece of heat shrink tubing over the remaining conductor, then solder it to the center pin of the SO-239 bulkhead, and shrink the tubing. Use the metric screws, washers, and nuts to bolt the SO-239 bulkhead to the slip cap, including the #4 ring terminal to one of the screws inside of the cap.

Cut a 3-½″ section off of the 24″ PVC tube. Drill a 3/16″ hole in the side of the PVC tube 1-½″ from one end, which I'll refer to as the *top end*. Drill another 3/16″ hole just ½″ below the top hole, placing it 1-½″ from the *bottom end*. Slip an eye bolt through a flat washer into the top hole, and tighten a washer and nut to it on the inside. Screw a nut onto a 1″ #8 screw, and slip the pair through one of the #8 ring terminals of the speaker wire, then through the bottom hole from the inside. Tighten a nut and washer onto the screw assembly from the outside. Repeat these two on the opposite side. Place the two assembled caps onto the tube, and the balun is complete. Once you make sure the connections are continuous, you're free to glue the caps on.



Completed "balun"

DIY, continued

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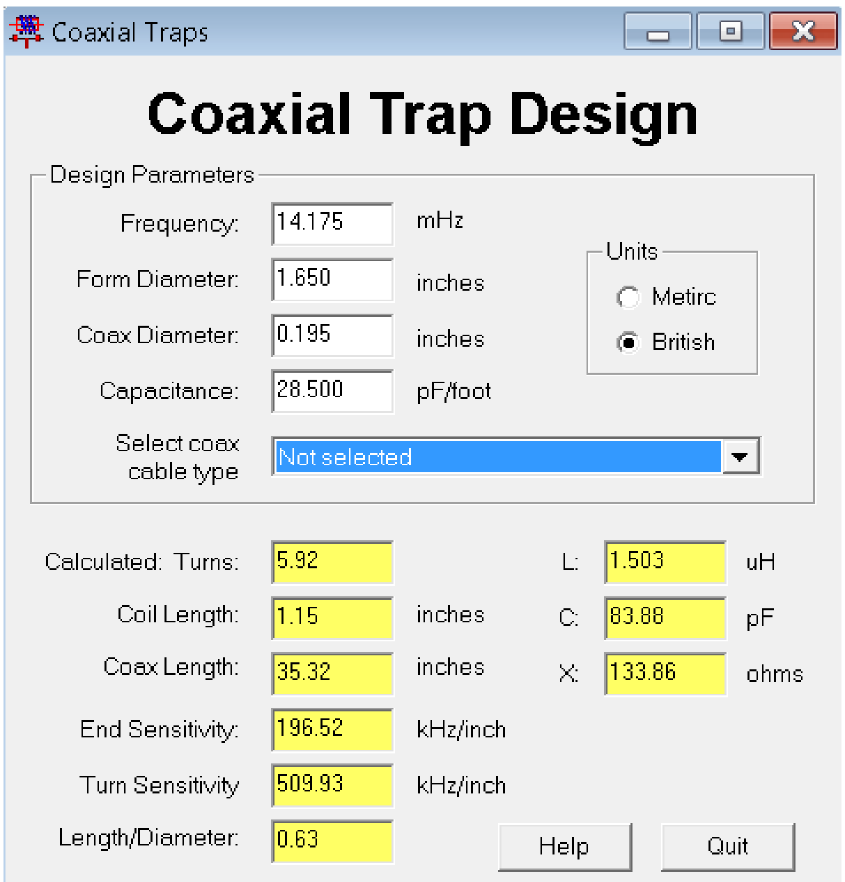
Trap construction

To construct each trap, start with a couple of known quantities, which are the 1-¼″ PVC tube (with an outside diameter of 1.65″) and some RG-58 coax. Using those, and the trap resonant frequency of 14.175 MHz, input those parameters to a coax trap calculator, such as that by Tony Fields VE6YP. This calculator displays the following:



The length of each trap tube needs to be about 0.2″ x 6 turns = 1.2″, plus an inch on each side of the coil for connections, = 3.2″, so cut two 3-¼″ sections of the PVC tube for the traps. Drill a 7/32″ hole about 1″ from the end. Insert about four inches of coax into the hole from the outside, then tightly wrap the coax around the tube 5.9 turns.

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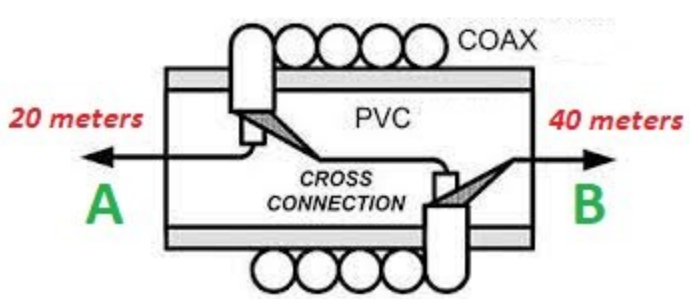
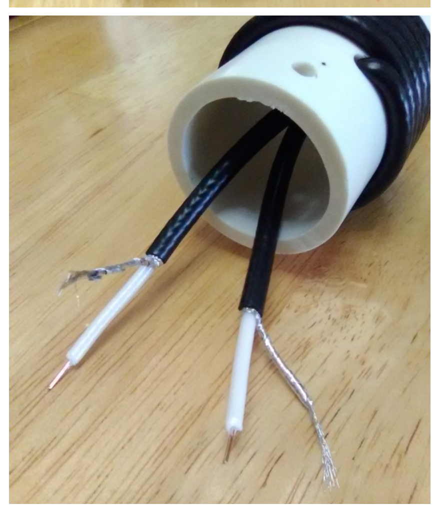
Mark on the tube where that 5.9-turn point is, then unwrap and remove the coax from the tube. Drill a second 7/32˝ hole at the mark. Re-insert the coax into the first hole, and tightly wrap the coax around the tube, cut the coax with about six inches of slack, and insert the newly cut end into the second hole to secure it.

Drill two 3/16˝ holes about 3/8˝ from each end, inline with each other, but between the two coax entry holes. Route both coax ends through one tube end, which I'll call "A" for convenience, and the other end "B". Also drill two 1/8˝ strain relief holes opposite the circumference of the two 3/16˝ holes.

Below is an illustration of what we're trying to accomplish in building each trap. Essentially, we're connecting the braid of the 20-meter end to the center of the 40-meter end, connecting the remaining ends to the antenna.





Cut off all but three inches of each coax sticking out of the tube, strip the coax, twist the braid together, and cut off the foil, if any.

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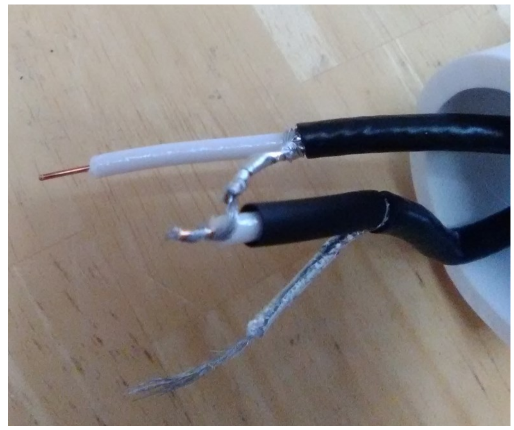
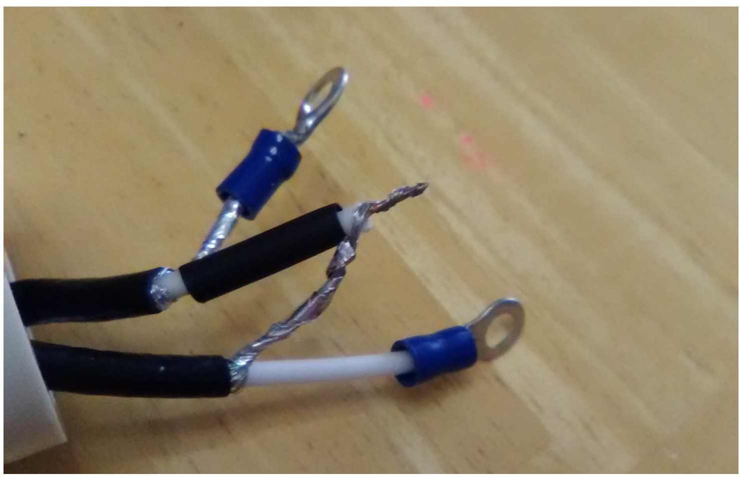
Slip a piece of heat shrink tubing over the coax B center conductor dielectric (white insulation), and twist the braid of coax A around the exposed coax B center conductor. Solder #8 ring terminals to the coax A center conductor and coax B braid, then heat-shrink the tubing.





Use #8 screws to bolt each ring terminal to its respective tube end, inside the tube. The trap is ready for use.

Element construction

Cut two 14 AWG wires 17 feet long for the 20-meter elements, and two more 11 feet long for the 40-meter elements. Thread each 20-meter element through a crimp sleeve (or other strain-relief device), through one of the balun eye bolts, then back through the crimp sleeve. Solder a #8 ring terminal to the end of the wire exiting the crimp sleeve, fasten the ring terminal to the balun with a nut, then crimp the sleeve. Thread the other end of the 20-meter element through another crimp sleeve, through the 1/8″ strain relief hole, then back through the crimp sleeve. Measure 16 feet 5 inches between the balun eye bolt and the 1/8″ hole, then crimp the sleeve.

Thread each 40-meter element through a crimp sleeve, through one of the balun eye bolts, then back through the crimp sleeve. Solder a #8 ring terminal to the end of the wire exiting the crimp sleeve, fasten the ring terminal to the balun with a nut, then crimp the sleeve. Thread the other end of the 40-meter eminent through another crimp sleeve, through a dogbone insulator, then back through the crimp sleeve. Measure 9 feet 10 inches between the 1/8″ strain relief hole and the dogbone insulator, then crimp the sleeve.

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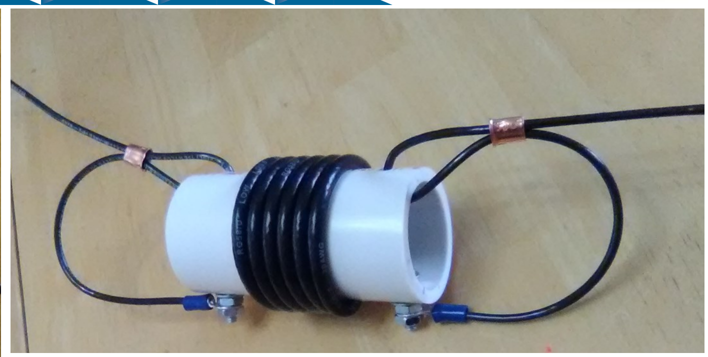
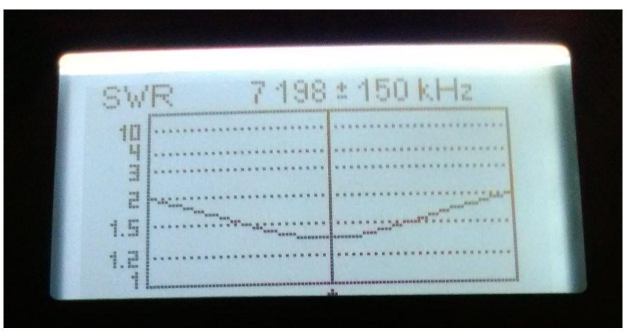
Completed balun, connected

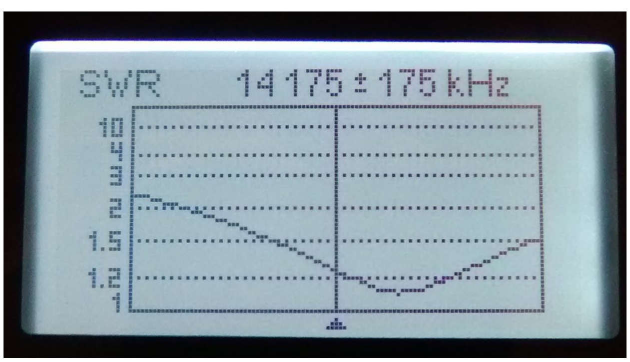


Completed trap, connected

Completed end of the antenna



40 meters is looking good



20 meters is almost as good

The final antenna ended up being about 53 feet long, which is perfect for a portable, dual-band dipole, and good for some attics.

Test time

I mounted the antenna about ten feet off the ground in a flat-top configuration. With the antenna so low to the ground, I wasn't expecting miracles, but the SWR across 40 meters turned out exceptionally well.

The results on 20 meters weren't quite as good, but weren't bad either. The entire phone portion of the 20-meter band ended up below 1.5:1 SWR, and nearly the entire band shows below 2.0:1 SWR, and the same with the 40-meter band. But keep in mind that I tested them just a few feet off the ground, so the impedances and performance will change somewhat, when I go to actually use it on the air. On the other hand, a good SWR across the bands low to the ground makes for good portable or NVIS operation.

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